FORM PTO 1390
(REV 11-98) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: SUNDS-123

U.S. APPLICATION NO. (If known, see 37 CFR 1 5): 09/936193

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATES	PRIORITY DATE CLAIMED
PCT/SE00/00411	02 MARCH 2000	10 MARCH 1999

TITLE OF INVENTION: SCREENING APPARATUS

APPLICANT(S) FOR DO/EO/US: Klas KRISTRÖM, et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to promptly begin national examination procedures (35 U.S.C. 371 (f)).
4. [X] The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371 (c)(2))
   a. [ ] is attached hereto (required only if not transmitted by the International Bureau).
   b. [X] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] An English language translation of the International Application as filed (35 U.S.C. 371 (c)(2)).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [X] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). (Executed)
10. [ ] An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98. w/PTO-1449, 25 references
12. [X] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 & 3.31 is included.
13. [X] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [X] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [X] Other items or information:

Substitute Abstract
Marked-up Specification
Copy of International Application as published
Copy of International Preliminary Examination Report w/annexes
Copy of International Search Report
Two (2) Sheets Formal Drawings

EXPRESS MAIL LABEL NO. EL807551129US
DATE: September 10, 2001

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/936193	PCT/SE00/00411	SUNDS-123

17. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) – (5)):

		CALCULATIONS PTO USE ONLY
[X]	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $1,000.00	
[ ]	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $860.00	
[ ]	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $710.00	
[ ]	International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) $690.00	
[ ]	International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00	

ENTER APPROPRIATE BASIC FEE AMOUNT =	1,000.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	*13 - 20 =		x $18.00		
Independent claims	2 - 3 =		x $80.00		
MULTIPLE DEPENDENT CLAIM(s) (if applicable)			+ $270.00		

TOTAL OF ABOVE CALCULATIONS =	1,000.00	
[ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.		
SUBTOTAL =	1,000.00	
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +		
TOTAL NATIONAL FEE =	1,000.00	
Fee for recording the enclosed assignment (37 CFR 1.21 (h)). Assignment must be accompanied by appropriate cover sheet (37 CFR 3.28, 3.31) + ($40.00 per property).	See recordation cover	
TOTAL FEES ENCLOSED =	1,000.00	
	Amount to be: Refunded	
	Charged	

*As In Preliminary Amendment

a. [ ] A check in the amount of _____ to cover the above fees is enclosed.

b. [X] Please charge my Deposit Account No. 12-1095 in the amount of $1,000.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required or credit any overpayment to my Deposit Account No. 12-1095 . A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Lerner, David, Littenberg, Krumholz & Mentlik, LLP
600 South Avenue West
Westfield, NJ 07090
Telephone 908 654-5000
Facsimile 908 654-7866

Signature

ARNOLD H. KRUMHOLZ
Name

25,428
Registration Number

PATENT
SUNDS 3.3-123

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of Klas KRISTRÖM *et al.*	:	
	:	Group Art Unit:
International Application No. PCT/SE00/00411	:	Examiner:
International Filing Date: March 2, 2000	:	Date: September 10, 2001
For: SCREENING APPARATUS	:	

Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Preliminary to initiation of the prosecution of the above-identified pending U.S. patent application, the following amendments and remarks are respectfully submitted.

IN THE ABSTRACT

Please delete the Abstract as filed and substitute therefor the attached revised Abstract.

IN THE SPECIFICATION

Please amend the Specification in accordance with the attached revised Specification.

IN THE CLAIMS

Please cancel claims 1-9 and add new claims 10-22.

10. (NEW) Apparatus for separating a fiber suspension comprising a housing, a stator mounted centrally within said housing, a rotary screen rotatably mounted between said housing and said stator thereby dividing said housing into a screen chamber between said housing and said rotary screen and an accept chamber between said rotary screen and said stator, an inlet for providing said fiber suspension to said screen chamber, a reject outlet for withdrawing rejected fiber suspension from said screen

chamber, and an accept outlet for withdrawing accepted fiber suspension from said accept chamber, said stator including at least one barrier member fixedly attached to said stator and extending axially along the length of said stator, said at least one barrier member extending radially from said stator to said rotary screen whereby said accepted fiber suspension is substantially prevented from tangentially passing said at least one barrier member and said at least one barrier member creates a pulse through said rotary screen.

11. (NEW) The apparatus of claim 10 wherein said fiber suspension comprises a pulp suspension.

12. (NEW) The apparatus of claim 10 wherein said at least one barrier member includes a pulse surface facing said rotary screen, said pulse surface having a shape such that the distance between said pulse surface and said rotary screen decreases in the direction of rotation of said rotary screen.

13. (NEW) The apparatus of claim 10 wherein said at least one barrier member extends outwardly from said stator in an axial direction towards said accept outlet and faces in a direction towards the direction of rotation of said rotary screen.

14. (NEW) The apparatus of claim 10 wherein said at least one barrier member extends radially outwardly from said stator at a predetermined angle.

15. (NEW) The apparatus of claim 14 wherein said predetermined angle is perpendicular or comprises an angle facing the direction of rotation of said rotary screen.

16. (NEW) The apparatus of claim 10 wherein said stator, said rotary screen and said housing each has the shape of a cylinder.

17. (NEW) The apparatus of claim 10 wherein said rotary screen has the shape of a cone, with an increase in diameter in the direction facing towards said accept outlet.

18. (NEW) The apparatus of claim 10 wherein said at least one barrier member comprises from 2 to 8 barrier members.

19. (NEW) The apparatus of claim 18 wherein said at least one barrier member comprises from 3 to 4 barrier members.

20. (NEW) The apparatus of claim 10 wherein the minimum distance between said at least one barrier member and said rotary screen is from 4 to 10 mm.

21. (NEW) The apparatus of claim 10 wherein said at least one barrier member comprises the outer surface of said stator.

22. (NEW) Apparatus for separating a fiber suspension through a rotary screen rotatably mounted within a housing, said apparatus comprising a stator mountable centrally within said housing and said rotary screen, said stator including at least one barrier member fixedly attached to said stator and extending axially along the length of said stator.

REMARKS

The above-noted cancellation of claims 1-9, and addition of new claims 10-22, as well as the submission of a new Abstract and revisions to the Specification, are respectfully submitted prior to initiation of the prosecution of this application in the U.S. Patent and Trademark Office.

The above-noted new claims are respectfully submitted in order to more clearly and appropriately claim the subject matter which applicants consider to constitute their inventive contribution. No new matter is included in these amendments. In addition, the revisions to the Abstract and Specification are submitted in order to clarify and correct the Abstract and Specification and to conform them to all of the requirements of U.S. practice. No new matter is included in these amendments.

In view of the above, it is respectfully requested that these amendments now be entered, and that prosecution on the merits of this application now be initiated. If, however, for any reason the Examiner does not believe such action can be taken, it is respectfully requested that he telephone applicant's attorney at (908) 654-5000 in order to overcome any objections which he may have.

If there are any additional charges in connection with this requested amendment, the Examiner is authorized to charge applicant's Deposit Account No. 12-1095 therefor.

Respectfully submitted,

LERNER, DAVID, LITTENBERG,
KRUMHOLZ & MENTLIK, LLP

ARNOLD H. KRUMHOLZ
Reg. No. 25,428

600 South Avenue West
Westfield, NJ 07090-1497
Telephone: (908) 654-5000
Facsimile: (908) 654-7866

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ABSTRACT OF THE DISCLOSURE

Apparatus for separating a fiber suspension is provided including a housing, a stator mounted within the housing, a rotary screen rotatably mounted within the housing, the stator dividing the housing into a screen chamber and an accept chamber, an inlet for fiber suspension, a reject outlet, and an accept outlet, the stator including at least one barrier member fixedly attached to the stator and extending axially along its length, and also extending radially from the stator to the rotary screen whereby the accepted fiber suspension is substantially prevented from tangentially passing the barrier member.

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SCREENING APPARATUS

FIELD OF THE INVENTION

[0001] ~~This~~ The present invention relates to a screening apparatus for separating fiber suspensions, preferably pulp suspensions. ~~The~~ More particularly, the present invention relates to screening apparatus ~~comprises~~ comprising a screen housing and centrally enclosed therein a stator, which is surrounded by a screen means co-axial with the stator and rotary about a rotor shaft. The screen means divides the interior of the screen housing into a screen chamber between the screen housing, and screen means and an accept chamber between the screen means and stator. The screening apparatus further comprises an inlet for the pulp suspension to the screen chamber, a reject outlet for reject from the screen chamber and an accept outlet for accept from the accept chamber.

BACKGROUND OF THE INVENTION

[0002] ~~Such screening~~ Screening apparatus of the type referred to above is used ~~at~~ during the coarse and fine screening of pulp suspensions, preferably for fractionating or separating ~~impurities and other~~ impurities which are not desired to be included in the final product, such as shives, coarse particles, scrap, stones or undigested or ~~not refined~~ unrefined chip bits. The screening apparatus ~~then~~ is usually ~~is~~ pressurized.

[0003] The pulp suspension to be screened is generally introduced ~~via~~ through the inlet to the screen chamber where the approved fraction, *i.e.*, the accept, flows through the rotating screen means. The accept is thereafter discharged through the accept outlet. In order to create suction pulses, pulse elements are provided on the stator. The pulse elements are designed as wings extending in the axial direction along the entire stator and screen means. The wings are arranged in ~~such~~ a manner~~,~~ such that the pulp suspension can pass between the wings and stator.

[0004] The portion of the pulp suspension which does not pass through the screen means (*i.e.*, the reject), is discharged ~~via~~ through a reject outlet, which is usually ~~is~~ located as a radial outlet at the lower portion of the screen housing.

[0005] A well-known problem in this connection~~, for example at~~ such as during the screening of papermaking pulp, is that the pulp suspension in the screen chamber, relatively close to the reject outlet, assumes a pulp concentration higher than that of the pulp suspension relatively close to the inlet. This is due to the fact that ~~at~~ during screening, the liquid in the pulp suspension is transported to and through the screen means at a higher speed than the fibers in the pulp suspension. Thus, a dewatering of the pulp suspension is obtained, which results in ~~that~~ the suspension increasingly ~~is~~ being thickened the closer ~~at~~ to the reject outlet it arrives. Thereby a thickened reject layer is obtained at the screen means near the reject outlet. The thickening increases still more ~~at~~ during a relatively low flow rate in the reject outlet, *i.e.*, at low reject discharge. ~~At~~ During heavy thickening a problem arises, ~~viz.~~ namely at the moment of transfer between screen housing and screen means at the thickened pulp suspension. This has a braking effect on the screen means, which causes increased energy consumption for rotating the screen means, and which may even result in stopping the screen means entirely. The thickening can also cause plugging and~~, thereby,~~ thus problems with removing the reject ~~via~~ through the reject outlet. ~~Today, it is~~ It is presently desired to be able to screen pulp suspensions with as high a pulp concentration as possible. The thickening, thus, becomes a great problem, because the pulp suspension ~~already at~~ during its introduction to the screen chamber already has a high concentration.

[0006] ~~The~~ One object of the present invention ~~has the object to show~~ is to provide an apparatus~~,~~ which to a great

extent reduces or eliminates the ~~stated~~ above-noted problems with thickening.

SUMMARY OF THE INVENTION

[0007] In accordance with the present invention, this and other objects have now been realized by the invention of appartus for separating a fiber suspension comprising a housing, a stator mounted centrally within the housing, a rotary screen rotatably mounted between the housing and the stator thereby dividing the housing into a screen chamber between the housing and the rotary screen and an accept chamber between the rotary screen and the stator, an inlet for providing the fiber suspension to the screen chamber, a reject outlet for withdrawing rejected fiber suspension from the screen chamber, and an accept outlet for withdrawing accepted fiber suspension from the accept chamber, the stator including at least one barrier member fixedly attached to the stator and extending axially along the length of the stator, the at least one barrier member extending radially from the stator to the rotary screen whereby the accepted fiber suspension is substantially prevented from tangentially passing the at least one barrier member and the at least one barrier member creates a pulse through the rotary screen. Preferably, the fiber suspension comprises a pulp suspension.

[0008] In accordance with one embodiment of the apparatus of the present invention, the at least one barrier member includes a pulse surface facing the rotary screen, the pulse surface having a shape such that the distance between the pulse surface and the rotary screen decreases in the direction of rotation of the rotary screen.

[0009] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier member extends outwardly from the stator in an axial direction towards the accept outlet and faces in a direction towards the direction of rotation of the rotary screen.

[00010] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier

member extends radially outwardly from the stator at a predetermined angle. Preferably, the predetermined angle is perpendicular or comprises an angle facing the direction of rotation of the rotary screen.

[00011] In accordance with another embodiment of the apparatus of the present invention, the stator, the rotary screen and the housing each has the shape of a cylinder.

[00012] In accordance with yet another embodiment of the apparatus of the present invention, the rotary screen has the shape of a cone, with an increase in diameter in the direction facing towards the accept outlet.

[00013] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier member comprises from 2 to 8 barrier members, and preferably from 3 to 4 barrier members.

[00014] In accordance with yet another embodiment of the apparatus of the present invention, the minimum distance between the at least one barrier member and the rotary screen is from 4 to 10 mm.

[00015] In accordance with another embodiment of the apparatus of the invention, the at least one barrier member comprises the outer surface of the stator.

[00016] In accordance with the present invention, apparatus is provided for separating a fiber suspension through a rotary screen rotatably mounted within a housing, the apparatus comprising a stator mountable centrally within the housing and the rotary screen, the stator including at least one barrier member fixedly attached to the stator and extending axially along the length of the stator.

[00017] ~~This object is~~ The objects of the present invention are achieved by a screen apparatus ~~of the kind described in the introductory portion,~~ which comprises at least one barrier and pulse element (barrier/pulse element). The barrier/pulse element is located on the stator and extends in the axial direction substantially along the entire stator and the entire screen means, and is capable upon rotation of the screen means

~~to create in addition to~~ of creating both suction pulses ~~also~~ and pressure pulses with respect to the pulp suspension in the screen chamber. The pressure pulses produce a substantially radially directed pump effect to the screen means and outwardly in the pulp suspension in the screen chamber, so that the reject continuously and ~~already~~ directly after the ~~start~~ beginning of the screen passes through the reject outlet. Consequently, substantially no thickened reject layer is built up, and the risk of plugging is reduced considerably. It is~~, thus,~~ therefore possible to screen at higher pulp concentrations without disturbances.

[00018] The barrier/pulse element, ~~contrary to~~ as contrasted with the pulse elements of the prior art, is attached tightly to the stator and extends from the stator outwardly to the screen means, so that the accept is substantially ~~is~~ prevented from tangentially passing the barrier/pulse element. The accept is thereby forced either to move axially to the accept outlet or, due to the pressure pulse, radially to the screen means, whereby the screen means is cleaned, and the pulp suspension in the screen chamber is mixed with that accept portion, which passes out through the screen means.

[00019] In addition to the aforementioned advantages, such a screen has proved to yield a uniform quality of the accept, even when the ~~inject~~ injected suspension has a non-uniform quality with regard to the content of, for example, shives, coarse particles, knots, incompletely digested or unrefined chip bits.

~~The characterizing features of the invention are apparent from the attached claims.~~

BRIEF DESCRIPTION OF THE DRAWINGS

[00020] The present invention is described in greater detail in the following~~, with reference~~ detailed description, which, in turn, refers to the accompanying drawings illustrating ~~an~~ one embodiment of the present invention~~.~~, as follows:

[00021] Fig. 1 ~~shows~~ is a side, elevational, partially sectional view of a screening apparatus according to the present invention~~,~~;

[00022] Fig. 2 is a ~~radial section~~ top, elevational, partially sectional view of the screening apparatus ~~according to the invention,~~ shown in Fig. 1;

[00023] Fig. 3 ~~shows an enlargement~~ is a top, elevational, enlarged, sectional view of the barrier/pulse element shown in Fig. 2~~,~~;

[00024] Fig. 4 ~~shows~~ is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element shown in Fig. 3~~,~~;

[00025] ~~Figs.~~ Fig. 5 ~~and 6 show other embodiments~~ is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element~~.~~ shown in Fig. 3; and

[00026] Fig. 6 is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element shown in Fig. 3.

DETAILED DESCRIPTION

[00027] The screening apparatus shown in Fig. I comprises a pressurized screen housing I with an upper portion 2, which has a greater diameter than the lower portion 3 of the screen housing. In the upper portion 2 of the screen housing I a substantially tangential inlet 4 is located for the fiber suspension to be separated, which in this example is a pulp

[00028] suspension. An accept outlet 5 for the accept is located substantially tangentially in the lower portion 3 of the screen housing I. A reject outlet 6 is located substantially axially and downwardly directed in the lower side of the upper portion 2, but radially ~~seen~~ outside the lower portion 3.

[00029] In the upper portion 2 of the screen housing a rotationally symmetrical screen means 7 is located so that it is rotary about a vertical rotor shaft 11. A stator 8 is located radially ~~seen~~ inside the screen means 7. The screen means 7 and stator 8 are arranged co-axially. The screen means

7 defines the upper portion 2 of the screen housing I in a screen chamber 9 between the screen housing I and screen means 7 and an accept chamber 10 between the screen means 7 and stator 8.

[00030] The screen means 7 can be ~~of~~ any type of screen means comprising screen apertures of a suitable size for passing through the desired portion of the pulp suspension. The screen means, for example, can have slits with openings between 0.1 mm and 0.5 mm, or holes with hole diameters between 0.1 mm and 12 mm, and ~~at~~ during coarse screening, preferably from ~~8-~~ to 10 mm.

[00031] In the lower portion 3 of the screen housing a lower accept chamber 13 is located which constitutes an extension of the accept chamber 10.

[00032] On the stator 8 four barrier/pulse elements 12 are located symmetrically. The barrier/pulse elements 12 can be one or more in number, but are suitably from ~~2-~~ to 8 and most ~~suitably~~ preferably from ~~3-~~ to 4, and are advantageously arranged symmetrically in the circumferential direction of the stator 8.

[00033] The barrier/pulse elements 12 extend in the axial direction along the entire stator and are attached tightly to the stator 8. They extend from the stator 8 and out to and along the entire screen means 7. The distance between the barrier/pulse elements 12 and screen means 7 shall be so ~~short~~ small that the accept (accepted suspension) substantially does not pass there between. A suitable minimum distance between the barrier/pulse element 12 and screen means 7 is from 4 to 10 mm. The accept chamber 10 is thereby divided into a number of smaller accept cells 10_1, 10_2, 10_3 and 10_4, each of which communicates with the lower accept chamber 13 in the lower portion 3 of the screen housing and thereby with the accept outlet 5.

[00034] ~~At~~ In the embodiment shown in the drawings, the barrier/pulse elements 12 extend in the axial direction straight downwardly from above. In order to assist in feeding

the accept in the accept 10_1, 10_2, 10_3 and 10_4 to the accept outlet 5, the barrier/pulse elements 12 can instead be designed so that, ~~they~~ as axially seen in the direction to the accept outlet 5 (in this example downward from above) they deflect in the rotational direction of the screen means. ~~Hereby~~ In this manner, the accept is guided more easily to the accept outlet 5, and a lower pressure drop above the stator 8 is obtained.

[00035] The pulp suspension to be separated is fed ~~via~~ through the inlet 4 into the screen chamber 9. The rotating screen means 7 ~~transfers~~ mechanically transfers energy to the pulp suspension in the screen chamber 9, which thereby follows the rotational direction of the screen means at the same time as it moves downwardly and thereby in a screwing movement moves down through the screen chamber 7. When the screen means rotates, a suction pulse arises on the rear side of the barrier/pulse element 12, as seen in the rotational direction. The accepted fraction of the pulp suspension ~~flows~~ thereby flows through the rotating screen means 7 and into one of the accept cells, 10_1, 10_2, 10_3 or 10_4. The main portion of the accept thereafter flows ~~thereafter~~ down to the lower accept chamber 13 and out through the accept outlet 5.

[00036] During the rotation of the screen means 7, the accept in the accept cells, 10_1, 10_2, 10_3 and 10_4, partially follows along in the rotation of the screen means 7. When the accept approaches the barrier/pulse element 12, portions of the accept are pressed back out through the screen means 7 and out into the screen chamber 9. ~~Thereby~~ In this manner, the screen means 7 is cleaned of possible ~~cloggings~~ clogging, and the pulp suspension in the screen chamber 9 is mixed with the accept fraction from the accept chamber 10. ~~Hereby~~ Thus, too heavy a thickening of the pulp suspension in the screen chamber 9 is prevented, and at the same time ~~also a~~ rotation of the accept in the same direction in the accept chamber 10 is prevented.

[00037] The portion of the pulp suspension in the screen chamber 9 which cannot pass through the screen means 7, continues to move in a screwing movement down through the screen chamber 9 and out through the reject outlet 6.

[00038] The barrier/pulse element 12, in order ~~upon rotation of the screen means 7~~ to produce strong pressure pulses to the pulp suspension in the screen chamber 9 upon rotation of the screen means 7, is suitably ~~is~~ designed as shown in Fig. 3. Facing toward the screen means 7, the barrier/pulse element 12 has a pulse surface 14, where the distance between the pulse surface 14 and screen means 7 decreases in the rotational direction of the screen means, to the point where the barrier/pulse element 12 is located closest to the screen means 7. When the accept approaches the barrier/pulse element 12, it is ~~thereby~~ thus forced, by the shape of the barrier/pulse element 12, out through the screen means 7 and out into the screen chamber 9.

[00039] In Fig. 4 the same design of the barrier/pulse element as in Fig. 3 is shown, but ~~here~~ in this case the barrier/pulse element is not attached to the stator 8, but is formed as ~~one~~ a single unit with the stator 8, which, of course, is also ~~is~~ possible.

[00040] Fig. 5 shows a different embodiment of the barrier/pulse element 12, which has a smaller pulse surface 14 than the barrier/pulse element in Fig. 3. This barrier/pulse element 12, thus, does not produce equally strong pressure pulses. Fig. 6 shows another different embodiment of the barrier/pulse element 12, which is designed as a curved metal sheet. The barrier/pulse element, of course, can also be designed in other ways.

[00041] The portion of the barrier/pulse element 12 which faces the rotational direction of the screen means 7, should be designed so that it assists in guiding the accept out to the screen means 7. This surface should, as seen radially from the inside of the stator 8 and out to the screen means, be

radial as in Fig. 5 or deflected in the rotational direction of the screen means 7, as in Fig. 6.

[00042] ~~At~~ In the embodiment shown in the drawings, the stator 8, screen means 7 and screen housing I outside the screen means 7 all have the form of a cylinder. One or ~~several~~ more of the stator, screen means and~~, respectively,~~ screen housing outside the screen means can also, for example, have a conical shape, with different or equal ~~angle~~ angular relations relative to one another. By forming the screen housing outside the stator, and~~, respectively,~~ forming the stator cylindrical or conical, it is possible to ~~change~~ alter the accessible space between them. By changing, for example, the screen means from cylindrical to conical in shape, the relationship between accessible space in the screen chamber and~~, respectively,~~ the accept chamber, respectively, can be ~~changed~~ altered. If accessible space ~~thereby~~ in axial direction thus becomes different, the space in the accept chamber should increase in the direction to the accept outlet, and the space in the screen chamber should be greatest at the inlet.

[00043] The accept outlet, reject outlet and inlet~~, of course,~~ can also be located in places in the screening apparatus other than those indicated ~~at~~ in the embodiment shown in the drawings. The accept outlet, for example, can be located in the upper portion of the screening apparatus, and the inlet an be located in the lower portion thereof. The reject outlet is suitably ~~is~~ located in the lower portion of the screening apparatus, in order to utilize the gravity at the separation of heavy foreign particles.

[00044] ~~At a~~ In one variant of the stator, in addition to barrier/pulse elements it can also be provided with pulse elements of a conventional type. It can, for example, be provided with 4 barrier/pulse elements and between them with ~~usual~~ conventional pulse elements, where the accept can pass between the wing and the stator.

[00045] A screening apparatus according to the present invention~~, of course,~~ can also be used separately as well as in combination with other screens in a common screen housing. ~~The invention, of course, is not restricted to the embodiment shown, but can be varied within the scope of the claims with reference to description and Figures.~~

[00046] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

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Screening apparatus

This invention relates to a screening apparatus for separating fiber suspensions, preferably pulp suspensions. The screening apparatus comprises a screen housing and centrally enclosed therein a stator, which is surrounded by a screen means co-axial with the stator and rotary about a rotor shaft. The screen means divides the interior of the screen housing into a screen chamber between the screen housing and screen means and an accept chamber between the screen means and stator. The screening apparatus further comprises an inlet for the pulp suspension to the screen chamber, a reject outlet for reject from the screen chamber and an accept outlet for accept from the accept chamber.

Such screening apparatus is used at the coarse and fine screening of pulp suspensions, preferably for fractionating or separating impurities and other impurities not desired to be included in the final product, such as shives, coarse particles, scrap, stones or undigested or not refined chip bits. The screening apparatus then usually is pressurized.

The pulp suspension to be screened is introduced via the inlet to the screen chamber where the approved fraction, the accept, flows through the rotating screen means. The accept is thereafter discharged through the accept outlet. In order to create suction pulses, pulse elements are provided on the stator. The pulse elements are designed as wings extending in axial direction along the entire stator and screen means. The wings are arranged in such a manner, that the pulp suspension can pass between the wings and stator.

The portion of the pulp suspension which does not pass through the screen means (the reject), is discharged via a reject outlet, which usually is located as a radial outlet at the lower portion of the screen housing.

A well-known problem in this connection, for example at the screening of papermaking pulp, is that the pulp suspension in the screen chamber, relatively close to the reject outlet, assumes a pulp concentration higher than that of the pulp suspension relatively

close to the inlet. This is due to the fact that at screening the liquid in the pulp suspension is transported to and through the screen means at a higher speed than the fibers in the pulp suspension. Thus, a dewatering of the pulp suspension is obtained, which results in that the suspension increasingly is thickened the closer at the reject outlet it arrives. Thereby a thickened reject layer is obtained at the screen means near the reject outlet. The thickening increases still more at a relatively low flow in the reject outlet, i.e. at low reject discharge. At heavy thickening a problem arises, viz. the moment transfer between screen housing and screen means at the thickened pulp suspension. This has a braking effect on the screen means, which causes increased energy consumption for rotating the screen means and may even result in stopping the screen means. The thickening can also cause plugging and, thereby, problems with removing the reject via the reject outlet. Today, it is desired to be able to screen pulp suspensions with as high a pulp concentration as possible. The thickening, thus, becomes a great problem, because the pulp suspension already at its introduction to the screen chamber has a high concentration.

The present invention has the object to show an apparatus, which to a great extent reduces or eliminates the stated problems with thickening.

This object is achieved by a screen apparatus of the kind described in the introductory portion, which comprises at least one barrier/pulse element. The barrier/pulse element is located on the stator and extends in axial direction substantially along the entire stator and entire screen means and is capable upon rotation of the screen means to create in addition to suction pulses also pressure pulses to the pulp suspension in the screen chamber. The pressure pulses produce a substantially radially directed pump effect to the screen means and outward in the pulp suspension in the screen chamber, so that the reject continuously and already directly after the start of the screen passes through the reject outlet. Consequently substantially no thickened reject layer is built up, and the risk of plugging is reduced considerably. It is, thus, possible to screen at higher pulp concentrations without disturbances.

close to the inlet. This is due to the fact that at screening the liquid in the pulp suspension is transported to and through the screen means at a higher speed than the fibers in the pulp suspension. Thus, a dewatering of the pulp suspension is obtained, which results in that the suspension increasingly is thickened the closer at the reject outlet it arrives Thereby a thickened reject layer is obtained at the screen means near the reject outlet. The thickening increases still more at a relatively low flow in the reject outlet, i.e. at low reject discharge. At heavy thickening a problem arises, viz. the moment transfer between screen housing and screen means at the thickened pulp suspension. This has a braking effect on the screen means, which causes increased energy consumption for rotating the screen means and may even result in stopping the screen means. The thickening can also cause plugging and, thereby, problems with removing the reject via the reject outlet. Today, it is desired to be able to screen pulp suspensions with as high a pulp concentration as possible. The thickening, thus, becomes a great problem, because the pulp suspension already at its introduction to the screen chamber has a high concentration.

The present invention has the object to show an apparatus, which to a great extent reduces or eliminates the stated problems with thickening.

This object is achieved by a screen apparatus of the kind described in the introductory portion, which comprises at least one barrier- and pulse element (barrier/pulse element). The barrier/pulse element is located on the stator and extends in axial direction substantially along the entire stator and entire screen means and is capable upon rotation of the screen means to create in addition to suction pulses also pressure pulses to the pulp suspension in the screen chamber. The pressure pulses produce a substantially radially directed pump effect to the screen means and outward in the pulp suspension in the screen chamber, so that the reject continuously and already directly after the start of the screen passes through the reject outlet. Consequently substantially no thickened reject layer is built up, and the risk of plugging is reduced considerably. It is, thus, possible to screen at higher pulp concentrations without disturbances.

The barrier/pulse element, contrary to the pulse elements of prior art, is attached tightly to the stator and extends from the stator outward to the screen means, so that the accept substantially is prevented from tangentially passing the barrier/pulse element. The accept is thereby forced either to move axially to the accept outlet or due to the pressure pulse radially to the screen means, whereby the screen means is cleaned, and the pulp suspension in the screen chamber is mixed with that accept portion, which passes out through the screen means.

In addition to the aforementioned advantages, such a screen has proved to yield a uniform quality of the accept even when the inject has a non-uniform quality with regard to the content of, for example, shives, coarse particles, knots, incompletely digested or unrefined chip bits.

The characterizing features of the invention are apparent from the attached claims.

The invention is described in greater detail in the following, with reference to the accompanying drawings illustrating an embodiment of the invention.

Fig. 1 shows a screening apparatus according to the invention,

Fig. 2 is a radial section of the screening apparatus according to the invention,

Fig. 3 shows an enlargement of the barrier/pulse element in Fig. 2,

Fig. 4 shows another design of the barrier/pulse element in Fig. 3,

Figs. 5 and 6 show other embodiments of the barrier/pulse element.

The screening apparatus in Fig. 1 comprises a pressurized screen housing 1 with an upper portion 2, which has a greater diameter than the lower portion 3 of the screen housing. In the upper portion 2 of the screen housing 1 a substantially tangential inlet 4 is located for the fiber suspension to be separated, which in this example is a pulp

suspension. An accept outlet 5 for the accept is located substantially tangentially in the lower portion 3 of the screen housing 1. A reject outlet 6 is located substantially axially and downward directed in the lower side of the upper portion 2, but radially seen outside the lower portion 3.

In the upper portion 2 of the screen housing a rotation symmetric screen means 7 is located so that it is rotary about a vertical rotor shaft 11. A stator 8 is located radially seen inside the screen means 7. The screen means 7 and stator 8 are arranged co-axially. The screen means 7 defines the upper portion 2 of the screen housing 1 in a screen chamber 9 between the screen housing 1 and screen means 7 and an accept chamber 10 between the screen means 7 and stator 8.

The screen means 7 can be of any type of screen means comprising screen apertures of a suitable size for passing through the desired portion of the pulp suspension. The screen means, for example, can have slits with openings between 0.1 mm and 0.5 mm, or holes with hole diameters between 0.1 mm and 12 mm, and at coarse screening preferably 8–10 mm.

In the lower portion 3 of the screen housing a lower accept chamber 13 is located which constitutes an extension of the accept chamber 10.

On the stator 8 four barrier/pulse elements 12 are located symmetrically. The barrier/pulse elements 12 can be one or more in number, but suitably 2–8 and most suitably 3-4, and advantageously arranged symmetrically in the circumferential direction of the stator 8.

The barrier/pulse elements 12 extend in axial direction along the entire stator and are attached tightly to the stator 8. They extend from the stator 8 and out to and along the entire screen means 7. The distance between the barrier/pulse elements 12 and screen means 7 shall be so short that the accept substantially does not pass therebetween.
A suitable minimum distance between the barrier/pulse element 12 and screen means 7 is 4 to 10 mm. The accept chamber 10 is thereby divided into a number of smaller

accept cells 10_1, 10_2, 10_3 and 10_4, each of which communicates with the lower accept chamber 13 in the lower portion 3 of the screen housing and thereby with the accept outlet 5.

At the embodiment shown, the barrier/pulse elements 12 extend in axial direction straight downward from above. In order to assist in feeding the accept in the accept cells 10_1, 10_2, 10_3 and 10_4 to the accept outlet 5, the barrier/pulse elements 12 can instead be designed so that they axially seen in the direction to the accept outlet 5 (in this example downward from above) deflect in the rotation direction of the screen means. Hereby the accept is guided more easily to the accept outlet 5, and a lower pressure drop above the stator 8 is obtained.

The pulp suspension to be separated is fed via the inlet 4 into the screen chamber 9. The rotating screen means 7 transfers mechanically energy to the pulp suspension in the screen chamber 9, which thereby follows the rotation direction of the screen means at the same time as it moves downward and thereby in a screwing movement moves down through the screen chamber 7. When the screen means rotates, a suction pulse arises on the rear side of the barrier/pulse element 12, seen in the rotation direction. The accepted fraction of the pulp suspension flows thereby through the rotating screen means 7 and into one of the accept cells 10_1, 10_2, 10_3 or 10_4. The main portion of the accept flows thereafter down to the lower accept chamber 13 and out through the accept outlet 5.

During the rotation of the screen means 7, the accept in the accept cells 10_1, 10_2, 10_3 and 10_4 partially follows along in the rotation of the screen means 7. When the accept approaches the barrier/pulse element 12, portions of the accept are pressed back out through the screen means 7 and out into the screen chamber 9. Thereby the screen means 7 is cleaned of possible cloggings, and the pulp suspension in the screen chamber 9 is mixed with the accept fraction from the accept chamber 10. Hereby too heavy a thickening of the pulp suspension in the screen chamber 9 is prevented, and at the same time also a rotation of the accept in the same direction in the accept chamber 10 is prevented.

The portion of the pulp suspension in the screen chamber 9 which cannot pass through the screen means 7, continues to move in a screwing movement down through the screen chamber 9 and out through the reject outlet 6.

The barrier/pulse element 12, in order upon rotation of the screen means 7 to produce strong pressure pulses to the pulp suspension in the screen chamber 9, suitably is designed as shown in Fig. 3. Facing toward the screen means 7, the barrier/pulse element 12 has a pulse surface 14, where the distance between the pulse surface 14 and screen means 7 descreases in the rotation direction of the screen means to the point where the barrier/pulse element 12 is located closest to the screen means 7. When the accept approaches the barrier/pulse element 12, it is thereby forced by the shape of the barrier/pulse element 12 out through the screen means 7 and out into the screen chamber 9.

In Fig. 4 the same design of the barrier/pulse element as in Fig. 3 is shown, but here the barrier/pulse element is not attached to the stator 8, but formed as one unit with the stator 8, which, of course, also is possible.

Fig. 5 shows a different embodiment of the barrier/pulse element 12, which has a smaller pulse surface 14 than the barrier/pulse element in Fig. 3. This barrier/pulse element 12, thus, does not produce equally strong pressure pulses. Fig. 6 shows another different embodiment of the barrier/pulse element 12, which is designed as a curved metal sheet. The barrier/pulse element, of course, can also be designed in other ways.

The portion of the barrier/pulse element 12 which faces the rotation direction of the screen means 7, should be designed so that it assists in guiding the accept out to the screen means 7. This surface should, seen radially from the inside of the stator 8 and out to the screen means, be radial as in Fig. 5 or deflected in rotation direction of the screen means 7 as in Fig. 6.

At the embodiment shown, the stator 8, screen means 7 and screen housing 1 outside the screen means 7 all have the form of a cylinder. One or several of the stator, screen

means and, respectively, screen housing outside the screen means can also, for example, have conic shape, with different or equal angle relations relative one another. By forming the screen housing outside the stator and, respectively, the stator cylindric or conical, it is possible to change the accessible space between them. By changing, for example, the screen means from cylindric to conical shape, the relation between accessible space in the screen chamber and, respectively, accept chamber can be changed. If accessible space thereby in axial direction becomes different, the space in the accept chamber should increase in the direction to the accept outlet, and the space in the screen chamber should be greatest at the inlet.

The accept outlet, reject outlet and inlet, of course, can be located in places in the screening apparatus other than indicated at the embodiment shown. The accept outlet, for example, can be located in the upper portion of the screening apparatus, and the inlet in the lower portion thereof. The reject outlet suitably is located in the lower portion of the screening apparatus, in order to utilize the gravity at the separation of heavy foreign particles.

At a variant of the stator, in addition to barrier/pulse elements it can also be provided with pulse elements of conventional type. It can, for example, be provided with 4 barrier/pulse elements and between them with usual pulse elements, where the accept can pass between the wing and stator.

A screening apparatus according to the invention, of course, can be used separately as well as in combination with other screens in a common screen housing.

The invention, of course, is not restricted to the embodiment shown, but can be varied within the scope of the claims with reference to description and Figures.

Claims

1. Screening apparatus for separating fiber suspensions, preferably pulp suspensions, comprising a pressurized screen housing (1), centrally located in the screen housing (1) a stator (8) enclosed by a screen means (7), which is rotary about a rotor shaft (11) and divides the interior of the screen housing (1) into a screen chamber (9) between the screen housing (1) and screen means (7) and an accept chamber (10) between the screen means (7) and stator (8), an inlet (4) for the fiber suspension to the screen chamber (9), a reject outlet (6) for reject from the screen chamber (9), and an accept outlet (5) for accept from the accept chamber (10), **characterized in** that on the stator (8) at least one barrier/pulse element (12) is located, which extends in axial direction along the entire stator (8) and substantially the entire screen means (7), and is tightly attached to the stator (8), and extends from the stator (8) out to the screen means (7), so that accept substantially is prevented from tangentially passing the barrier/pulse element (12).

2. Apparatus as defined in claim 1, **characterized in** that the barrier/pulse element (12) facing the screen means (7) has a pulse surface (14), where the distance between the pulse surface (14) and screen means (7) decreases in the rotation direction of the screen means.

3. Apparatus as defined in claim 1 or 2, **characterized in** that the barrier/pulse element (12) axially seen in the direction to the accept outlet (5) deflects in the rotation direction of the screen means (7).

4. Apparatus as defined in any of the preceding claims, **characterized in** that the portion of the barrier/pulse element (12) facing the rotation direction of the screen means (7), seen radially from the inside of the stator (8) and out to the screen means (7), is radial or deflects in the rotation direction of the screen means (7).

5. Apparatus as defined in any one of the preceding claims, **characterized in** that the stator (8), screen means (7) and screen housing (1) outside the screen means (7) all have the shape of a cylinder.

6. Apparatus as defined in any one of the claims 1-5, **characterized in** that the screen means (7) is conical with increasing diameter in the direction to the accept outlet (5).

7. Apparatus as defined in any one of the preceding claims, **characterized in** that on the stator (8) 2 to 8, but suitably 3 to 4 barrier/pulse elements (12) are located.

8. Apparatus as defined in any one of the preceding claims, **characterized in** that the minimum distance between the barrier/pulse element (12) and screen means (7) is 4 to 10 mm.

9. Stator for use in a screening apparatus defined in any one of the preceding claims, **characterized in** that the stator (8) is provided with at least one barrier/pulse element (12), which extends in axial direction along the entire stator (8) and is tightly attached to the stator (8).

Claims

1. Screening apparatus for separating fiber suspensions, preferably pulp suspensions, comprising a pressurized screen housing (1), centrally located in the screen housing (1) a stator (8) enclosed by a screen means (7), which is rotary about a rotor shaft (11) and divides the interior of the screen housing (1) into a screen chamber (9) between the screen housing (1) and screen means (7) and an accept chamber (10) between the screen means (7) and stator (8), an inlet (4) for the fiber suspension to the screen chamber (9), a reject outlet (6) for reject from the screen chamber (9), and an accept outlet (5) for accept from the accept chamber (10), **characterized in** that on the stator (8) at least one barrier- and pulse element (12) is located, which extends in axial direction along the entire stator (8) and substantially the entire screen means (7), and is tightly attached to the stator (8), and extends from the stator (8) out to the screen means (7), so that accept substantially is prevented from tangentially passing the barrier- and pulse element (12) and the barrier- pulse element (12) is capable upon rotation of the screen means (7) to create suction pulses and pressure pulses to the fiber suspension in the screen chamber (9).

2. Apparatus as defined in claim 1, **characterized in** that the barrier- and pulse element (12) facing the screen means (7) has a pulse surface (14), where the distance between the pulse surface (14) and screen means (7) decreases in the rotation direction of the screen means.

3. Apparatus as defined in claim 1 or 2, **characterized in** that the barrier- and pulse element (12) axially seen in the direction to the accept outlet (5) deflects in the rotation direction of the screen means (7).

4. Apparatus as defined in any of the preceding claims, **characterized in** that the portion of the barrier- and pulse element (12) facing the rotation direction of the screen means (7), seen radially from the inside of the stator (8) and out to the screen means (7), is radial or deflects in the rotation direction of the screen means (7).

5. Apparatus as defined in any one of the preceding claims, **characterized in** that the stator (8), screen means (7) and screen housing (1) outside the screen means (7) all have the shape of a cylinder.

6. Apparatus as defined in any one of the claims 1-5, **characterized in** that the screen means (7) is conical with increasing diameter in the direction to the accept outlet (5).

7. Apparatus as defined in any one of the preceding claims, **characterized in** that on the stator (8) 2 to 8, but suitably 3 to 4 barrier- and pulse elements (12) are located.

8. Apparatus as defined in any one of the preceding claims, **characterized in** that the minimum distance between the barrier- and pulse element (12) and screen means (7) is 4 to 10 mm.

9. Stator for use in a screening apparatus defined in any one of the preceding claims, **characterized in** that the stator (8) is provided with at least one barrier- and pulse element (12), which extends in axial direction along the entire stator (8) and is tightly attached to the stator (8).

SCREENING APPARATUS

FIELD OF THE INVENTION

[0001] The present invention relates to a screening apparatus for separating fiber suspensions, preferably pulp suspensions. More particularly, the present invention relates to screening apparatus comprising a screen housing and centrally enclosed therein a stator, which is surrounded by a screen means co-axial with the stator and rotary about a rotor shaft. The screen means divides the interior of the screen housing into a screen chamber between the screen housing, and screen means and an accept chamber between the screen means and stator. The screening apparatus further comprises an inlet for the pulp suspension to the screen chamber, a reject outlet for reject from the screen chamber and an accept outlet for accept from the accept chamber.

BACKGROUND OF THE INVENTION

[0002] Screening apparatus of the type referred to above is used during the coarse and fine screening of pulp suspensions, preferably for fractionating or separating impurities which are not desired to be included in the final product, such as shives, coarse particles, scrap, stones or undigested or unrefined chip bits. The screening apparatus is usually pressurized.

[0003] The pulp suspension to be screened is generally introduced through the inlet to the screen chamber where the approved fraction, *i.e.*, the accept, flows through the rotating screen means. The accept is thereafter discharged through the accept outlet. In order to create suction pulses, pulse elements are provided on the stator. The pulse elements are designed as wings extending in the axial direction along the entire stator and screen means. The wings are arranged in a manner such that the pulp suspension can pass between the wings and stator.

[0004] The portion of the pulp suspension which does not pass through the screen means (*i.e.*, the reject), is

discharged through a reject outlet, which is usually located as a radial outlet at the lower portion of the screen housing.

[0005] A well-known problem in this connection such as during the screening of papermaking pulp, is that the pulp suspension in the screen chamber, relatively close to the reject outlet, assumes a pulp concentration higher than that of the pulp suspension relatively close to the inlet. This is due to the fact that during screening, the liquid in the pulp suspension is transported to and through the screen means at a higher speed than the fibers in the pulp suspension. Thus, a dewatering of the pulp suspension is obtained, which results in the suspension increasingly being thickened the closer to the reject outlet it arrives. Thereby a thickened reject layer is obtained at the screen means near the reject outlet. The thickening increases still more during a relatively low flow rate in the reject outlet, *i.e.*, at low reject discharge. During heavy thickening a problem arises, namely at the moment of transfer between screen housing and screen means at the thickened pulp suspension. This has a braking effect on the screen means, which causes increased energy consumption for rotating the screen means, and which may even result in stopping the screen means entirely. The thickening can also cause plugging and thus problems with removing the reject through the reject outlet. It is presently desired to be able to screen pulp suspensions with as high a pulp concentration as possible. The thickening, thus, becomes a great problem, because the pulp suspension during its introduction to the screen chamber already has a high concentration.

[0006] One object of the present invention is to provide an apparatus which to a great extent reduces or eliminates the above-noted problems with thickening.

SUMMARY OF THE INVENTION

[0007] In accordance with the present invention, this and other objects have now been realized by the invention of appartus for separating a fiber suspension comprising a housing, a stator mounted centrally within the housing, a

rotary screen rotatably mounted between the housing and the stator thereby dividing the housing into a screen chamber between the housing and the rotary screen and an accept chamber between the rotary screen and the stator, an inlet for providing the fiber suspension to the screen chamber, a reject outlet for withdrawing rejected fiber suspension from the screen chamber, and an accept outlet for withdrawing accepted fiber suspension from the accept chamber, the stator including at least one barrier member fixedly attached to the stator and extending axially along the length of the stator, the at least one barrier member extending radially from the stator to the rotary screen whereby the accepted fiber suspension is substantially prevented from tangentially passing the at least one barrier member and the at least one barrier member creates a pulse through the rotary screen. Preferably, the fiber suspension comprises a pulp suspension.

[0008] In accordance with one embodiment of the apparatus of the present invention, the at least one barrier member includes a pulse surface facing the rotary screen, the pulse surface having a shape such that the distance between the pulse surface and the rotary screen decreases in the direction of rotation of the rotary screen.

[0009] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier member extends outwardly from the stator in an axial direction towards the accept outlet and faces in a direction towards the direction of rotation of the rotary screen.

[00010] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier member extends radially outwardly from the stator at a predetermined angle. Preferably, the predetermined angle is perpendicular or comprises an angle facing the direction of rotation of the rotary screen.

[00011] In accordance with another embodiment of the apparatus of the present invention, the stator, the rotary screen and the housing each has the shape of a cylinder.

[00012] In accordance with yet another embodiment of the apparatus of the present invention, the rotary screen has the shape of a cone, with an increase in diameter in the direction facing towards the accept outlet.

[00013] In accordance with another embodiment of the apparatus of the present invention, the at least one barrier member comprises from 2 to 8 barrier members, and preferably from 3 to 4 barrier members.

[00014] In accordance with yet another embodiment of the apparatus of the present invention, the minimum distance between the at least one barrier member and the rotary screen is from 4 to 10 mm.

[00015] In accordance with another embodiment of the apparatus of the invention, the at least one barrier member comprises the outer surface of the stator.

[00016] In accordance with the present invention, apparatus is provided for separating a fiber suspension through a rotary screen rotatably mounted within a housing, the apparatus comprising a stator mountable centrally within the housing and the rotary screen, the stator including at least one barrier member fixedly attached to the stator and extending axially along the length of the stator.

[00017] The objects of the present invention are achieved by a screen apparatus which comprises at least one barrier and pulse element (barrier/pulse element). The barrier/pulse element is located on the stator and extends in the axial direction substantially along the entire stator and the entire screen means, and is capable upon rotation of the screen means of creating both suction pulses and pressure pulses with respect to the pulp suspension in the screen chamber. The pressure pulses produce a substantially radially directed pump effect to the screen means and outwardly in the pulp suspension in the screen chamber, so that the reject continuously and directly after the beginning of the screen passes through the reject outlet. Consequently, substantially no thickened reject layer is built up, and the risk of

plugging is reduced considerably. It is therefore possible to screen at higher pulp concentrations without disturbances.

[00018] The barrier/pulse element, as contrasted with the pulse elements of the prior art, is attached tightly to the stator and extends from the stator outwardly to the screen means, so that the accept is substantially prevented from tangentially passing the barrier/pulse element. The accept is thereby forced either to move axially to the accept outlet or, due to the pressure pulse, radially to the screen means, whereby the screen means is cleaned, and the pulp suspension in the screen chamber is mixed with that accept portion, which passes out through the screen means.

[00019] In addition to the aforementioned advantages, such a screen has proved to yield a uniform quality of the accept, even when the injected suspension has a non-uniform quality with regard to the content of, for example, shives, coarse particles, knots, incompletely digested or unrefined chip bits.

BRIEF DESCRIPTION OF THE DRAWINGS

[00020] The present invention is described in greater detail in the following detailed description, which, in turn, refers to the accompanying drawings illustrating one embodiment of the present invention, as follows:

[00021] Fig. 1 is a side, elevational, partially sectional view of a screening apparatus according to the present invention;

[00022] Fig. 2 is a top, elevational, partially sectional view of the screening apparatus shown in Fig. 1;

[00023] Fig. 3 is a top, elevational, enlarged, sectional view of the barrier/pulse element shown in Fig. 2;

[00024] Fig. 4 is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element shown in Fig. 3;

[00025] Fig. 5 is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element shown in Fig. 3; and

[00026] Fig. 6 is a top, elevational, enlarged, sectional view of another design of the barrier/pulse element shown in Fig. 3.

DETAILED DESCRIPTION

[00027] The screening apparatus shown in Fig. I comprises a pressurized screen housing I with an upper portion 2, which has a greater diameter than the lower portion 3 of the screen housing. In the upper portion 2 of the screen housing I a substantially tangential inlet 4 is located for the fiber suspension to be separated, which in this example is a pulp

[00028] suspension. An accept outlet 5 for the accept is located substantially tangentially in the lower portion 3 of the screen housing I. A reject outlet 6 is located substantially axially and downwardly directed in the lower side of the upper portion 2, but radially outside the lower portion 3.

[00029] In the upper portion 2 of the screen housing a rotationally symmetrical screen means 7 is located so that it is rotary about a vertical rotor shaft 11. A stator 8 is located radially inside the screen means 7. The screen means 7 and stator 8 are arranged co-axially. The screen means 7 defines the upper portion 2 of the screen housing I in a screen chamber 9 between the screen housing I and screen means 7 and an accept chamber 10 between the screen means 7 and stator 8.

[00030] The screen means 7 can be any type of screen means comprising screen apertures of a suitable size for passing through the desired portion of the pulp suspension. The screen means, for example, can have slits with openings between 0.1 mm and 0.5 mm, or holes with hole diameters between 0.1 mm and 12 mm, and during coarse screening, preferably from 8 to 10 mm.

[00031] In the lower portion 3 of the screen housing a lower accept chamber 13 is located which constitutes an extension of the accept chamber 10.

[00032] On the stator 8 four barrier/pulse elements 12 are located symmetrically. The barrier/pulse elements 12 can be one or more in number, but are suitably from 2 to 8 and most preferably from 3 to 4, and are advantageously arranged symmetrically in the circumferential direction of the stator 8.

[00033] The barrier/pulse elements 12 extend in the axial direction along the entire stator and are attached tightly to the stator 8. They extend from the stator 8 and out to and along the entire screen means 7. The distance between the barrier/pulse elements 12 and screen means 7 shall be so small that the accept (accepted suspension) substantially does not pass there between. A suitable minimum distance between the barrier/pulse element 12 and screen means 7 is from 4 to 10 mm. The accept chamber 10 is thereby divided into a number of smaller accept cells 10_1, 10_2, 10_3 and 10_4, each of which communicates with the lower accept chamber 13 in the lower portion 3 of the screen housing and thereby with the accept outlet 5.

[00034] In the embodiment shown in the drawings, the barrier/pulse elements 12 extend in the axial direction straight downwardly from above. In order to assist in feeding the accept in the accept 10_1, 10_2, 10_3 and 10_4 to the accept outlet 5, the barrier/pulse elements 12 can instead be designed so that, as axially seen in the direction to the accept outlet 5 (in this example downward from above) they deflect in the rotational direction of the screen means. In this manner, the accept is guided more easily to the accept outlet 5, and a lower pressure drop above the stator 8 is obtained.

[00035] The pulp suspension to be separated is fed through the inlet 4 into the screen chamber 9. The rotating screen means 7 mechanically transfers energy to the pulp suspension in the screen chamber 9, which thereby follows the rotational direction of the screen means at the same time as it moves downwardly and thereby in a screwing movement moves down

through the screen chamber 7. When the screen means rotates, a suction pulse arises on the rear side of the barrier/pulse element 12, as seen in the rotational direction. The accepted fraction of the pulp suspension thereby flows through the rotating screen means 7 and into one of the accept cells, 10_1, 10_2, 10_3 or 10_4. The main portion of the accept thereafter flows down to the lower accept chamber 13 and out through the accept outlet 5.

[00036] During the rotation of the screen means 7, the accept in the accept cells, 10_1, 10_2, 10_3 and 10_4, partially follows along in the rotation of the screen means 7. When the accept approaches the barrier/pulse element 12, portions of the accept are pressed back out through the screen means 7 and out into the screen chamber 9. In this manner, the screen means 7 is cleaned of possible clogging, and the pulp suspension in the screen chamber 9 is mixed with the accept fraction from the accept chamber 10. Thus, too heavy a thickening of the pulp suspension in the screen chamber 9 is prevented, and at the same time rotation of the accept in the same direction in the accept chamber 10 is prevented.

[00037] The portion of the pulp suspension in the screen chamber 9 which cannot pass through the screen means 7, continues to move in a screwing movement down through the screen chamber 9 and out through the reject outlet 6.

[00038] The barrier/pulse element 12, in order to produce strong pressure pulses to the pulp suspension in the screen chamber 9 upon rotation of the screen means 7, is suitably designed as shown in Fig. 3. Facing toward the screen means 7, the barrier/pulse element 12 has a pulse surface 14, where the distance between the pulse surface 14 and screen means 7 decreases in the rotational direction of the screen means, to the point where the barrier/pulse element 12 is located closest to the screen means 7. When the accept approaches the barrier/pulse element 12, it is thus forced, by the shape of the barrier/pulse element 12, out through the screen means 7 and out into the screen chamber 9.

[00039] In Fig. 4 the same design of the barrier/pulse element as in Fig. 3 is shown, but in this case the barrier/pulse element is not attached to the stator 8, but is formed as a single unit with the stator 8, which, of course, is also possible.

[00040] Fig. 5 shows a different embodiment of the barrier/pulse element 12, which has a smaller pulse surface 14 than the barrier/pulse element in Fig. 3. This barrier/pulse element 12, thus, does not produce equally strong pressure pulses. Fig. 6 shows another different embodiment of the barrier/pulse element 12, which is designed as a curved metal sheet. The barrier/pulse element, of course, can also be designed in other ways.

[00041] The portion of the barrier/pulse element 12 which faces the rotational direction of the screen means 7, should be designed so that it assists in guiding the accept out to the screen means 7. This surface should, as seen radially from the inside of the stator 8 and out to the screen means, be radial as in Fig. 5 or deflected in the rotational direction of the screen means 7, as in Fig. 6.

[00042] In the embodiment shown in the drawings, the stator 8, screen means 7 and screen housing I outside the screen means 7 all have the form of a cylinder. One or more of the stator, screen means and screen housing outside the screen means can also, for example, have a conical shape, with different or equal angular relations relative to one another. By forming the screen housing outside the stator, and forming the stator cylindrical or conical, it is possible to alter the accessible space between them. By changing, for example, the screen means from cylindrical to conical in shape, the relationship between accessible space in the screen chamber and the accept chamber, respectively, can be altered. If accessible space in axial direction thus becomes different, the space in the accept chamber should increase in the direction to the accept outlet, and the space in the screen chamber should be greatest at the inlet.

[00043] The accept outlet, reject outlet and inlet can also be located in places in the screening apparatus other than those indicated in the embodiment shown in the drawings. The accept outlet, for example, can be located in the upper portion of the screening apparatus, and the inlet an be located in the lower portion thereof. The reject outlet is suitably located in the lower portion of the screening apparatus, in order to utilize the gravity at the separation of heavy foreign particles.

[00044] In one variant of the stator, in addition to barrier/pulse elements it can also be provided with pulse elements of a conventional type. It can, for example, be provided with 4 barrier/pulse elements and between them with conventional pulse elements, where the accept can pass between the wing and the stator.

[00045] A screening apparatus according to the present invention can also be used separately as well as in combination with other screens in a common screen housing.

[00046] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

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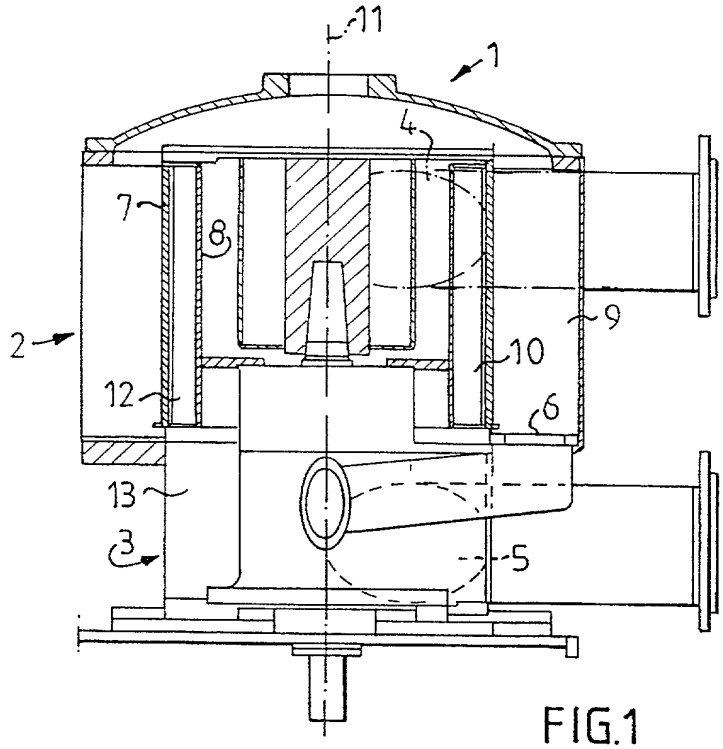

FIG.1

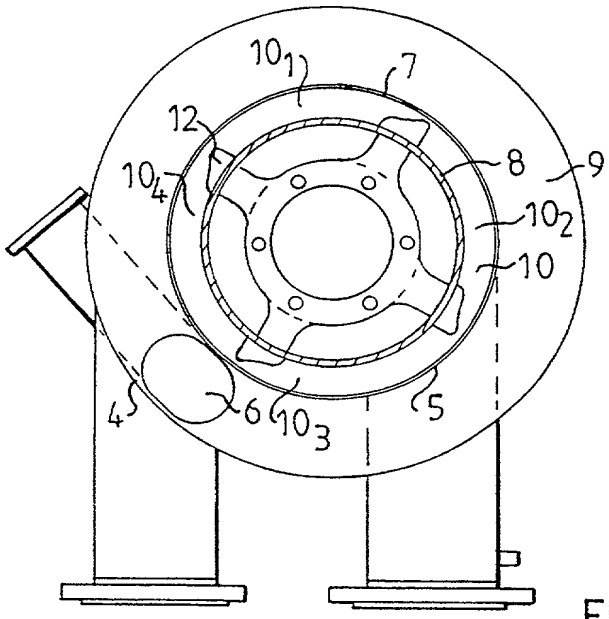

FIG. 2

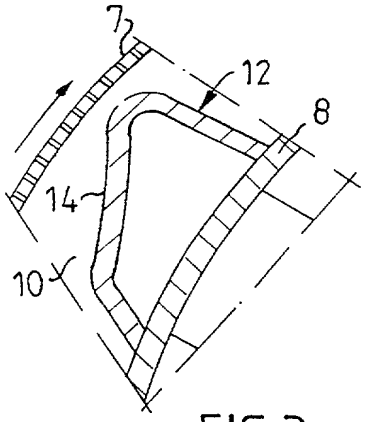

FIG. 3

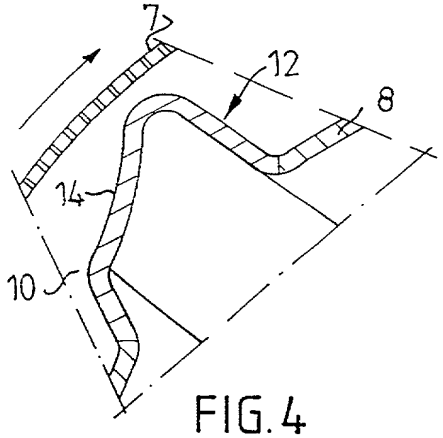

FIG. 4

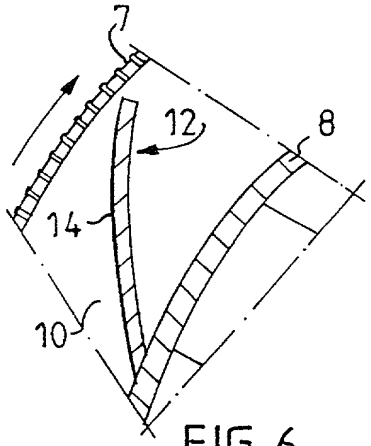

FIG. 6

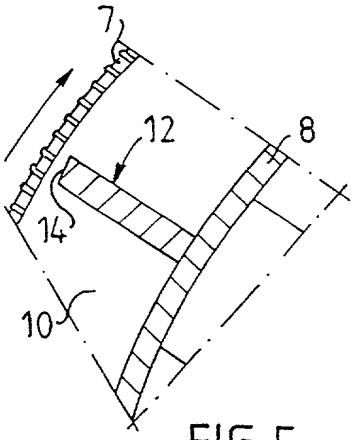

FIG. 5

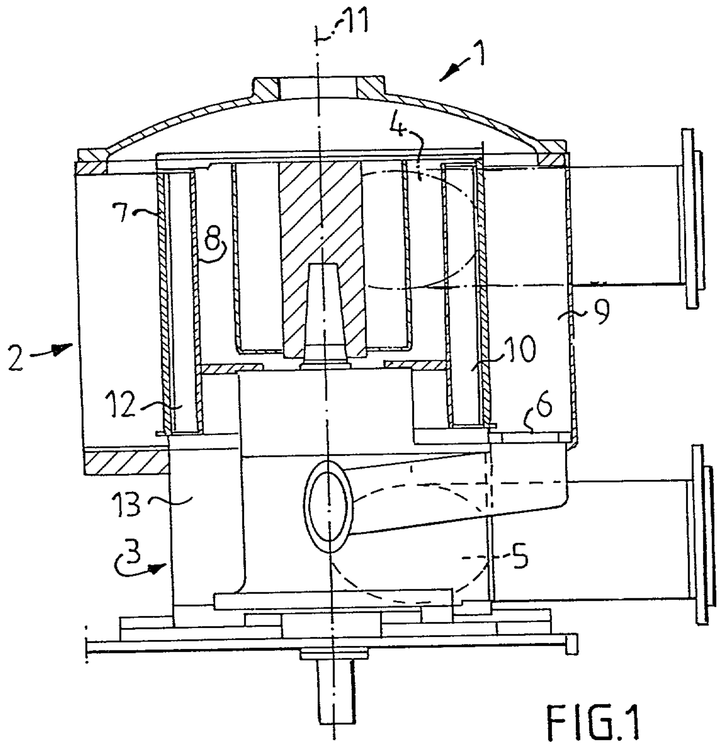

FIG.1

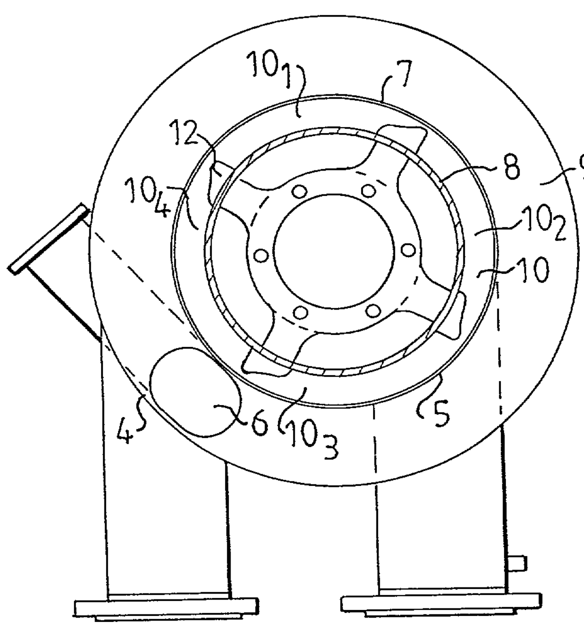

FIG. 2

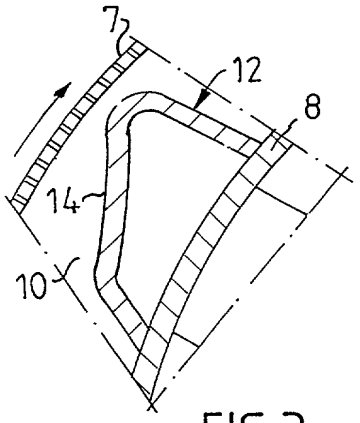

FIG. 3

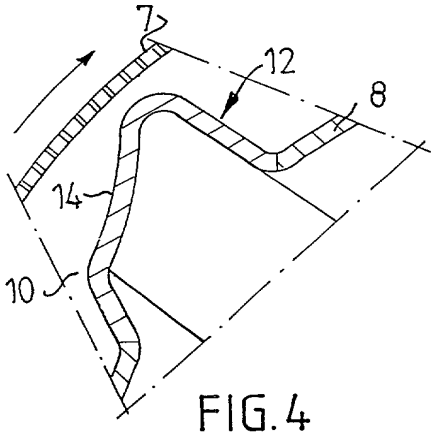

FIG. 4

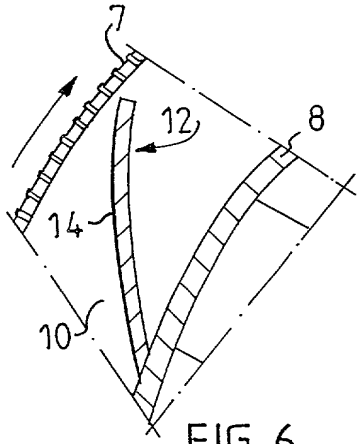

FIG. 6

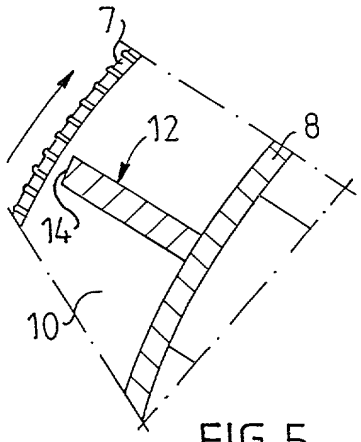

FIG. 5

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION

2001 -08- 13 ATTORNEY'S DOCKET NO.: SUNDS-123

As a below-named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name;
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: SCREENING APPARATUS, the specification of which

☐ is attached hereto
☒ was filed on March 2, 2000 as United States Application Number or PCT International Application Number PCT/SE00/00411 and was amended on October 3, 2000 (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (month, day, year)	PRIORITY CLAIMED
Sweden	9900869-0	March 10, 1999	YES ☒ NO ☐
			YES ☐ NO ☐
			YES ☐ NO ☐
LISTING OF FOREIGN APPLICATIONS CONTINUED ON PAGE 3 HEREOF ☐ YES ☒ NO			

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Application Number: _____ Filing Date: _____

Application Number: _____ Filing Date: _____

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or § 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. Parent Application Serial Number: _____ Parent Filing Date: _____ Parent Patent No.: _____

U.S. Parent Application Serial Number: _____ Parent Filing Date: _____ Parent Patent No.: _____

PCT Parent Number: _____ Parent Filing Date: _____

LISTING OF US APPLICATIONS CONTINUED ON PAGE 3 HEREOF: ☐ YES ☒ NO

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Lawrence I. Lerner, Reg. No. 19,516; Sidney David, Reg. No. 22,768, Joseph S. Littenberg, Reg. No. 20,832; Arnold H. Krumholz, Reg. No. 25,428, William L. Mentlik, Reg No. 27,106; John R. Nelson, Reg. No. 26,573; Roy H. Wepner, Reg. No. 28,350; Stephen B. Goldman, Reg No. 28,512; Paul H. Kochanski, Reg. No. 29,660; Marcus J. Millet, Reg. No. 28,241; Bruce H. Sales, Reg. No. 32,793; Daniel H. Bobis, Reg No. 18,694; Peter J. Butch III, Reg No. 32,203, Keith E. Gilman, Reg. No. 32,137, Robert B. Cohen, Reg. No 32,768, Arnold B. Dompieri, Reg. No. 29,736, Michael H. Teschner, Reg. No. 32,862; Gregory S. Gewirtz, Reg. No 36,522; Jonathan A. David, Reg No 36,494, Shawn P. Foley, Reg. No. 33,071; Thomas M. Palisi, Reg. No. 36,628; Michael J. Doherty, Reg. No. 40,592; John P. Maldjian, Reg. No P-41,967

SEND CORRESPONDENCE TO:	DIRECT TELEPHONE CALLS TO:
LERNER, DAVID, LITTENBERG, KRUMHOLZ & MENTLIK 600 South Avenue West Westfield, New Jersey 07090	*(name and telephone number)* ARNOLD H. KRUMHOLZ (908) 654-5000 Fax: (908) 654-7866

DECLARATION -- Page 2

ATTORNEY DOCKET NO. SUNDS-123

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

Full name of sole or first inventor (given name, family name): Klas Kriström

Inventor's signature Klas Kriström Date August 27, 2001

Residence: SÖRBERGE, Sweden SEX Citizenship: Swedish

Post Office Address: Stänkvägen 13, S-860 30 SÖRBERGE, Sweden

2-00

Full name of second joint inventor, if any (given name, family name): Kjell Forslund

Second Inventor's signature Kjell Forslund Date August 27, 2001

Residence: SUNDSBRUK, Sweden SEX Citizenship: Swedish

Post Office Address: Bruksgårdsvägen 4, S-863 31 SUNDSBRUK, Sweden

3-00

Full name of third joint inventor, if any (given name, family name): Tomas Wikström

Third Inventor's signature [illegible] Date August 27, 2001

Residence: SUNDSVALL, Sweden SEX Citizenship: Swedish

Post Office Address: Lysekilsvägen 45, S-857 33 SUNDSVALL, Sweden

Full name of fourth joint inventor, if any (given name, family name):

Fourth Inventor's signature Date

Residence: Citizenship:

Post Office Address:

Full name of fifth joint inventor (given name, family name):

Fifth Inventor's signature Date

Residence: Citizenship:

Post Office Address:

Full name of sixth joint inventor, if any (given name, family name):

Sixth Inventor's signature Date

Residence: Citizenship:

Post Office Address:

Full name of seventh joint inventor, if any (given name, family name):

Seventh Inventor's signature Date

Residence: Citizenship:

Post Office Address:

Full name of eighth joint inventor, if any (given name, family name):

Eighth Inventor's signature Date

Residence: Citizenship:

Post Office Address:

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